**Method for producing cookware, in particular a pot, pan or similar and cookware produced according to said method**

The invention relates to a method for producing cookware composed of a base body and a bottom attached thereto, in particular a pot, a pan or the like, in which in a first step of said method, the base body is formed as one integral piece, preferably by means of deep-drawing, and in a second step of said method, the base body is connected to the preferably multi-part bottom, which comprises an inlay as well as a capsule, which receives said inlay.

Pots, pans or similar cookware are principally known in the state of the art and have proved a success in daily practical use. However, modern cookware has to meet higher and higher quality requirements, so that there is still a need of innovations.

Thus, modern cookware does not only have to meet the requirement to assure an impeccable preservation and heating of food, but it also has to meet high requirements with respect to aesthetics, which in particular influences the selection of usable materials. Furthermore, in modern kitchens, very different forms of stoves for heating food are used, which respectively require different qualities of cookware material. Usual cooker forms are for example gas cookers, electric cookers and induction cookers. Herein, the induction cooker, in comparison to gas cookers or electric cookers, has the particularity that no heat transfer between the cooker on the one hand and the cookware on the other hand takes place, since the cookware is directly heated by building up an induction field. However, the use of an induction cooker requires that at least the bottom of the cookware used in combination with the induction cooker is made of inductive material.

In order to meet the different requirements of the material used for cookware, it is known in the state of the art to use material combinations, wherein it has in particular become common to use different materials for the base body of the cookware, on the one hand, and the bottom of the cookware, which is attached to the base body, on the other hand. It is also known to form the bottom of the cookware as a so called sandwich bottom and to provide different material layers depending on the desired material

properties. However, when the cookware is properly heated, it has proved to be disadvantageous that the use of different materials leads to a delay, in particular in the area of the bottom of the cookware. This is caused by the different coefficients of thermal expansion of the respectively used materials, such that the heating leads to material dependent differences of expansion, which result in the consequence that certain areas of the cookware expand or shrink differently under heat influence. This effect proves extremely disadvantageous for the so called sandwich bottoms, since due to the different material expansions, it cannot be assured, within the entire temperature range, that the cookware completely leans on the surface of the cooking area of the cooker. On the contrary, a deformation of the bottom is caused during the heating of the cookware, which leads to the fact that the entire surface of the bottom is not in contact with the cooking area of the cooker, but only certain areas of the bottom. The contact area between the cooking area of the cooker and the bottom of the cookware, which depends on the ruling temperature, makes the obtained heat transfer between cooker and cookware vary in a disadvantageous way, so that it is not possible to precisely regulate the heat quantity that shall be transferred to the cookware. Furthermore, the thermally caused barrelling of the bottom, which causes the cookware bottom to rest on the cooking area of the cooker only in certain areas, can provoke tilting motions of the cookware with respect to the cooking area. This is not only a drawback with respect to security aspects, but the user of the cookware will perceive the smallest thermal deformation of the cookware bottom, which will make him doubt of the quality of the cookware used by him. A thermally caused concave bulging of the bottom is equally disadvantageous, since in this case, an air buffer, which acts as isolator, is formed between the cookware bottom on the one hand and the cooking area of the cooker on the other hand, whereby the desired heating of the cookware is adversely affected.

The previously described drawbacks have an even stronger effect, if the cookware shall also be used in combination with an induction cooker. In this case, the bottom of the cookware has namely to be at least partially made of an inductive material, which increases the variety of the materials combined with each other.

On the base of the above mentioned facts, it is the o b j e c t of the invention to provide a method for producing cookware, which simultaneously enables a simple and economic realization and the production of cookware, which comprises a bottom that

only deforms within narrow tolerance limits, even when subjected to comparatively high thermal stress. The invention shall also propose a cookware.

This a l m is achieved by the invention in that it proposes a method for producing cookware composed of a base body and a bottom attached thereto, in particular a pot, a pan or the like, in which in a first step of said method, the base body is formed as one integral piece, preferably by means of deep-drawing, and in a second step of said method, the base body is connected to the preferably multi-part bottom, which comprises an inlay as well as a capsule, which receives said inlay, characterized in that the bottom is calibrated by means of a pressing device having a position control, preferably a toggle press.

The particularity of the method according to the invention is the calibration of the bottom by means of a pressing device having a position control. Hereby, it is advantageously achieved that, independent from the force to be used, the bottom is always identically formed. This enables reproducibility within the narrowest range of tolerance, since in contrast to a force-controlled pressing operation, the desired forming of the bottom is always obtained, which is in particular advantageous, if the bottom of the cookware, which is composed of different material components, consists of several parts. Consequently, the application of the method according to the invention leads to the production of a cookware bottom, which only presents a small deformation, even if subjected to a comparatively high thermal stress, which deformation has a value of $\leq$ 0.7%, preferably $\leq$ 0.35% of the bottom diameter. Thus, if the cookware produced according to said method is used according to the intended purpose, the bottom is neither affected by an undesirable bulging inwards nor by an undesirable bulging outwards. This helps to advantageously avoid both the danger of a tilting slope resulting form the barrelling of the bottom and the danger of an air buffer isolation, which is formed as a result of the convex bulging of the bottom, including the tendency to burned edges. To the contrary, due to the calibration carried out according to the invention, a forming of the cookware bottom is achieved, which provides for the substantially planar rest of the cookware bottom on the cooking area of the cooker, if used within the usual temperature range, whereby an optimized heating of the cookware can be achieved.

According to another proposal of the invention, it is intended to form a mechanically reinforced bottom. Complementary to the forming of the cookware bottom obtained by means of the calibration, this measure leads to an additional form stability, which advantageously causes the bottom to remain free of deformation nearly within the entire temperature range, which assures a planar rest of the cookware bottom on the cooking area of the cooker, even at different temperatures. This increases the stability of the cookware on the one hand, and on the other hand, tilting motions of the cookware, which are perceived by the customer as in particular a defect as to quality, are efficiently prevented. According to a special proposal of the invention, it is intended to press reinforcing ribs into the lower side of the cookware bottom. The reinforcing ribs are preferably ribs which are vaulted towards the base body and which are stamped into the lower side of the cookware bottom by using a corresponding die or a corresponding stamping device. Herein, according to the preferably used stamp pattern, a correspondingly formed die or a correspondingly formed stamping device can be used, such that the ribs, which are intended to reinforce the cookware bottom, can be formed in only one stamping step.

In order to assure the reproducibility of the method according to the invention, another aspect of the invention proposes to carry out the forming of the reinforcing ribs in a position controlled manner. Hereby, it is advantageously achieved that, independent from the force to be applied, the forming of the reinforcing ribs is always the same. Hereby, it is achieved that, independent from eventual tolerances of the thickness of the cookware bottom, i.e. of the inlay or the capsule, always equal reinforcing ribs are formed, such that cookware produced according to the method of the invention always meets the same quality requirements. A force controlled forming of the reinforcing ribs would not be able to assure a reproducibility in this sense, since dependent on geometric tolerances, which inevitably arise in the course of carrying out the method, cookware dependent press forces have to be applied for forming the reinforcing ribs, such that with a force controlled method, there would be quality differences in the forming of the reinforcing ribs. In order to avoid this disadvantage and to assure the reproducibility of the cookware produced according to the method of the invention, it is intended according to the invention to carry out the forming of the reinforcing ribs in a position controlled manner.

According to another aspect of the invention, the reinforcing ribs are stamped into the cookware bottom with simultaneous calibration. By calibration one has to understand a deformation of the cookware bottom, according to which, at room temperature, the bottom has a slightly inwards bulged, i.e. convex form with respect to the lower side of the bottom. At a higher temperature, that acts upon the cookware bottom, this one will expand against the convex bulging provided at room temperature while supporting the reinforcing ribs, such that the cookware bottom will rest in a planar manner on the cooking area of the cooker within the temperature range that is interesting for the proper use of the cookware.

According to another aspect of the invention, the base body and the bottom are welded or soldered to each other. With respect to welding, the so called press welding is an advantageous option. Herein, the parts to be connected to each other are pressed onto each other with high pressure and simultaneously interconnected in an adhesive bond by supplying corresponding energy. According to an alternative realization of the method, the base body and the bottom can be connected to each other by means of soldering, wherein according to this realization of the method, the components to be connected to each other are heated in a furnace with preceding spreading of a solder that can be spread. For connecting the bottom and the base body by means of press welding, it is intended according to a special aspect of the invention to carry out the connection of base body and bottom as well as the calibration and optionally also the forming of the reinforcing ribs in one process step. This measure enables an in particular cost efficient and over all quick carrying out of the method, since it is only required to provide the base body as first component and the bottom as second component and then to connect them to each other in only one working step in order to form the finished cookware. If necessary, further process steps for cleaning, polishing or other treatment of the cookware can follow after finishing the cookware according to the invention. However, it is decisive, that the cookware according to the invention can be finished in only one process step.

For carrying out the method according to the invention, the invention further proposes a device, which is characterized by a pressing device having a position control. Hereby, the above described reproducibility of the calibration and the reinforcing ribs, which shall be formed into the cookware bottom, is achieved. As pressing device, a toggle press is

preferably used, which works like a four-bar chain and is moved from an upper dead centre into a lower dead centre during the pressing operation. The distance, which is thus covered by the compression moulding die, is always the same, such that independent from eventual geometric tolerances of the cookware to be produced, the forming of the reinforcing ribs is always the same.

According to another aspect of the invention it is intended that the device comprises concave force plugs. Hereby, a calibration of the cookware bottom is achieved, which results in an inwards bulged, i.e. convex form with respect to the lower side of the bottom, which leads to the above described advantages. Furthermore, it is possible that the force plug located on the side of the bottom of the cookware comprises a so called pattern in form of a positive stamp of the pattern of the reinforcing ribs, which shall be stamped into the bottom of the cookware. The bottom of the cookware can thus be calibrated and provided with the reinforcing ribs according to the invention in only one pressing operation.

According to another aspect of the invention it is intended that the pressing device comprises a pot receiving portion, which can be moved relatively to the first one. This kind of design advantageously allows a simplified carrying out of the method, since due to the movable cookware receiving portion, the pressing device can be filled or finished cookware can be removed from the pressing device in a comfortable way for the operator.

For the s o l u t l o n of the above mentioned task, it is proposed, with respect to the cookware, to form cookware, in particular a pot, pan or the like, which is composed of a preferably cylindric base body and a bottom attached to the base body, characterized in that the bottom is convex, i.e. bulged inwards with respect to the lower side thereof, such that the deformation of the bottom, which is caused by a thermal stress, has a value of $\leq$ 0.7%, preferably $\leq$ 0.35% of the bottom diameter, for which purpose the bottom is calibrated in a position controlled manner.

This design of the cookware bottom according to the invention allows the bottom to be nearly completely exempt from deformation, even if subjected to a comparatively high thermal stress, so that convex or concave bulging of the cookware bottom has a

comparatively small value with respect to the bottom diameter. Herein, the deformation of the bottom resulting from a thermal stress is $\leq$ 0.7%, preferably $\leq$ 0.5%, preferably $\leq$ 0.35% with respect to the bottom diameter.

In spite of the eventual use of very different materials, the design of the cookware bottom according to the invention is able to substantially resist a deformation caused by thermal stress. In contrast to cookware known in the state of the art, the calibration of the bottom, which is carried out in a position controlled manner, permits to obtain a forming, which acts against the thermal tensions generated due to the different coefficients of expansion of the different materials during a heating of the cookware and thus minimizes them, so that the forces are equilibrated inside the cookware bottom. Hereby, a deformation of the cookware bottom can be essentially avoided.

According to a special aspect of the invention, the cookware bottom is mechanically reinforced. This leads to the formation of mechanical barriers, which additionally increase the mechanical flexural resistance of the cookware. In a design of the bottom according to the invention, also materials having very different coefficients of thermal expansion can be combined with each other without provoking a deformation of the cookware bottom, since the mechanical barriers act against the different material expansions, which are generated due to a thermal stress, and the inner forces related thereto, which supports the forming of the bottom produced by the calibration.

According to a further aspect of the invention, the bottom comprises reinforcing ribs. These ones are preferably grooves, which are formed in the cookware bottom and positioned, such that they increase the mechanical flexural resistance of the entire cookware bottom. The grooves can be integrated by means of a pressing operation, in which the grooves are stamped into the cookware bottom using corresponding dies. By the term reinforcing ribs one has to understand any forms of impression, which act in the previously described sense as mechanical barriers and act against a deformation of the cookware bottom caused by thermal tensions.

The grooves formed in the cookware bottom are preferably arranged in a uniform pattern. Hereby, a compensation of forces is advantageously achieved, which equally acts over the entire cookware bottom, such that also with thermal tensions, which only

occur in certain areas, which is for example the case if the cookware is only partially in contact with the heated cooking area of the cooker, a thermally caused deformation of the cookware bottom is prevented. The arrangement of the reinforcing ribs in form of a uniform pattern can be for example achieved according to a characteristic of the invention, in that the pattern has a rotation or mirror symmetry. Other arrangement forms of the reinforcing ribs are of course possible, since in the sense of the invention it is only important that the arrangement of the reinforcing ribs additionally increases the mechanical flexural resistance of the cookware bottom, such that this one resists its own tensions caused by thermal stress essentially without any deformation.

According to another aspect of the invention it is intended, that the base body is formed by a side wall, which encloses a volume, and which comprises a first end area and a second end area opposing the first one, wherein the first end area is open and can be closed by a cover and the second end area is closed. Herein, the base body is preferably produced as one integral piece and is for example made of a rust-proof material, such as e.g. stainless steel. This kind of design of the base body advantageously enables to select the base body material with respect to the material properties thereof, such that it is particularly suitable for the later contact with the food to be heated in the cookware. Herein, stainless steel is in particular suitable, because this one is easy to clean and also material resistant against possibly aggressive foodstuffs. Furthermore, it also resists mechanical pressure and/or impact stresses, such as they can for example occur during a proper use by using kitchen utensils, such as for example wooden spoons or the like.

According to another aspect of the invention, the bottom is a multi-part piece and comprises an inlay as well as a capsule, which receives said inlay. Such a material combination used for the cookware bottom helps to obtain a design which meets several requirements. The capsule, which receives said inlay, can thus be made of e.g. a magnetizable material, preferably a ferritic stainless steel, so that the cookware according to the invention is also suitable for the use in combination with an induction cooker. The inlay received by the capsule is preferably made of a highly thermoconducting material, such as e.g. aluminium or magnesium. Hereby, an improved heat transfer is achieved, such that altogether a quicker heating of the foodstuffs in the cookware with less heat loss can be achieved.

According to another aspect of the invention, it is intended that the base body and the bottom are soldered or welded to each other. A permanent connection, which also resists mechanical influences, between base body on the one hand and bottom on the other hand is thus assured. A good heat transferability between bottom and base body is also assured.

Other advantages and characteristics of the invention will appear from the following description made with respect to the figures. Herein:

Fig. 1: is a schematic sectional view of an embodiment of the cookware according to the invention in form of a pot;

Fig. 2: is a schematic view from below of the cookware according to the invention from fig. 1 and

Fig. 3: is a partially sectional side view of the cookware according to the invention during the pressing operation.

Fig. 1 is a partially sectional side view, which represents the cookware according to the invention in form of a pot 1. Pot 1 is composed of a base body 5 and a bottom 2, which are preferably welded to each other.

Said base body 5 is formed by a side wall, which encloses a volume and which comprises a first end area 3 and a second end area 4 opposing the first one, wherein the first end area 3 is open and can be closed by a cover. The second end area 4 is closed and is adjacent to bottom 2. Base body 5 is preferably made of a rust-proof material, for example stainless steel.

Concerning bottom 2, it is a multi-part piece and comprises an inlay 6 as well as a capsule 7, which receives said inlay 6. Inlay 6 is preferably made of a thermoconducting material, such as e.g. aluminium. In contrast to this, capsule 7, which receives said inlay 6, is made of a preferably magnetizable material, for example a ferritic stainless steel, such that pot 1 according to the invention can also be used in combination with an induction cooker.

Fig. 2 shows pot 1 according to fig. 1 in a view from below. One can see that the side of bottom 2, which is opposing base body 5, is provided with reinforcing ribs 8, which have the form of grooves stamped into the bottom. Due to the formation of the reinforcing ribs 8, a mechanical reinforcement of bottom 2 is achieved, which acts as mechanical barrier and results in an increased flexural resistance of bottom 2. The thermal tensions, which are caused by the different coefficients of thermal expansion of the used materials during a heating of pot 1, can thus be compensated, such that bottom 2 nearly remains exempt of deformation, even if subjected to high thermal stresses of pot 1. This is not only an advantage with respect to security aspects, but tilting motions can also be prevented, which would otherwise occur with a bottom, that is not exempt of deformation. Hereby, a uniform heating of the cookware bottom with a simultaneous shortening of the heating up period required for a desired heating is achieved.

Fig. 3 is a schematic representation, which shows the arrangement of pot 1 according to the invention in a pressing device, which is no further represented in details, and which comprises the two force plugs 9 and 10. When the method is carried out, the upper force plug 10 is moved downwards in the direction of force plug 9 in a position controlled manner. Pot 1, which is situated between the two force plugs, is hereby compressed in the area of bottom 2 of pot 1, which results in a calibration of the bottom and in the complementary stamping of the reinforcing ribs 8 represented in fig. 2 into the lower side of bottom 2. For the purpose of calibration, the two force plugs 9 and 10 are preferably concave on the side of the pot, such that the finished pot bottom has an inwards bulged, i.e. convex form.

**List of reference numerals:**

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| 1 | pot |
| 2 | bottom |
| 3 | open end area |
| 4 | closed end area |
| 5 | base body |
| 6 | inlay |
| 7 | capsule |
| 8 | reinforcing rib |
| 9 | force plug |
| 10 | force plug |